UNITED AIRLINES

GROUND PROXIMITY WARNING SYSTEM - DESCRIPTION AND OPERATION

1. General (Fig. 1)
   A. The ground proximity warning system (GPWS) provides the pilots with aural and visual warning of potentially dangerous flight paths relative to the ground. The GPWS processes radio altitude information from the No. 1 low range radio altimeter (LRRA), mach signal and altitude rate information from the central air data computer (CADC) glide slope deviation information from VOR/ILS system and landing gear and landing flap position signals to provide warnings of the following hazards:
      (1) Excessive rate of descent (Mode 1).
      (2) Level flight or too shallow climb towards rising terrain (Mode 2).
      (3) Takeoff altitude loss (Mode 3).
      (4) Unsafe terrain clearance (Mode 4).
      (5) Excessive deviation below the glide slope (Mode 5).
      (6) Descent below decision height (DH) (Mode 6).
   B. GPWS consists of a ground proximity warning computer, a warning light labeled PULL UP, a test switch, a glide slope advisory light labeled BELOW G/S, an inhibit switch labeled PUSH TO INHIBIT, and a monitor light labeled GPWS INOP. In addition, the warning is audible through the pilot's interphone speakers.
   C. Primary power for the system is 115 volts ac supplied from the essential flight instrument bus in panel P7 through a circuit breaker labeled GROUND PROX WARN CMPTR.
   D. The CADC also supplies 26 volts ac as a reference voltage for the altitude rate circuits.
2. Computer
   A. The ground proximity warning computer (GPWC) is rack-mounted on shelf No. 1 of electronic equipment rack E2. The GPWC consists of a logic and power supply module, a comparator and closure warning, audio, voice, glide slope, monitor, and self-test modules. A power transformer and an interference capacitor are also mounted in the rear of the chassis above the electrical connector.
3. Warning Indicator Light (Fig. 1)
   A. A rectangular shaped red warning light labeled PULL UP is installed on the pilots' lightshield. The light has a light-test feature which is controlled by the master dim and test switch. Access to the bulbs and a fuse within the light assembly is provided by removing the lens cover.
   B. The light comes on to provide a visual indication that the GPWC has generated a warning of an unsafe flight path.
4. Advisory Light
   A. A rectangular shaped amber advisory light labeled BELOW G/S is installed on the pilots' lightshield. Access to the bulbs and a fuse within the light assembly is provided by removing the lens cover.
   B. The light comes on flashing to provide a visual indication that the airplane is below the glide slope beam when an ILS frequency is selected.
5. GPWS Test Switch
   A. The GPWS TEST switch is located on the center instrument panel. It provides a confidence check of the system either on ground or in flight.
6. GPWS Inhibit Switch

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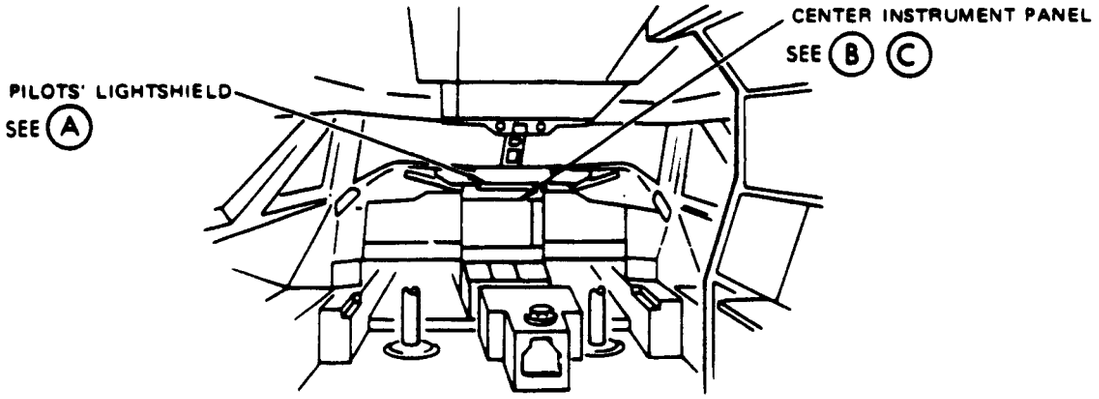

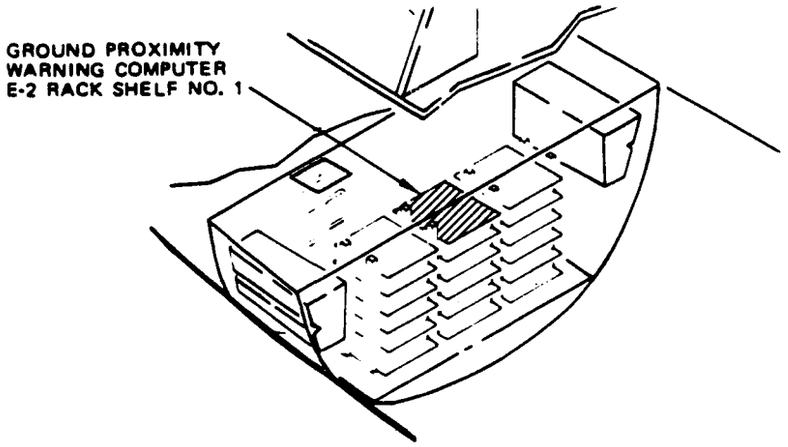

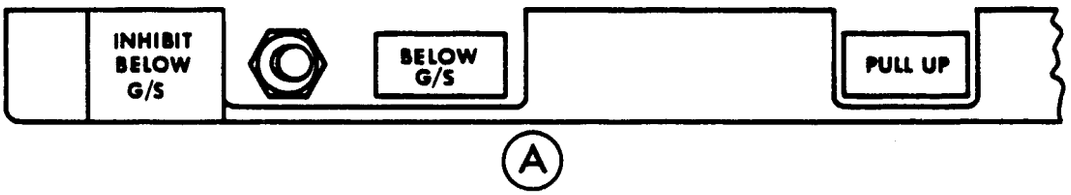

A

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C

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FIGURE 1 (SHEET 1 OF 2) - GROUND PROXIMITY WARNING SYSTEM COMPONENT LOCATION

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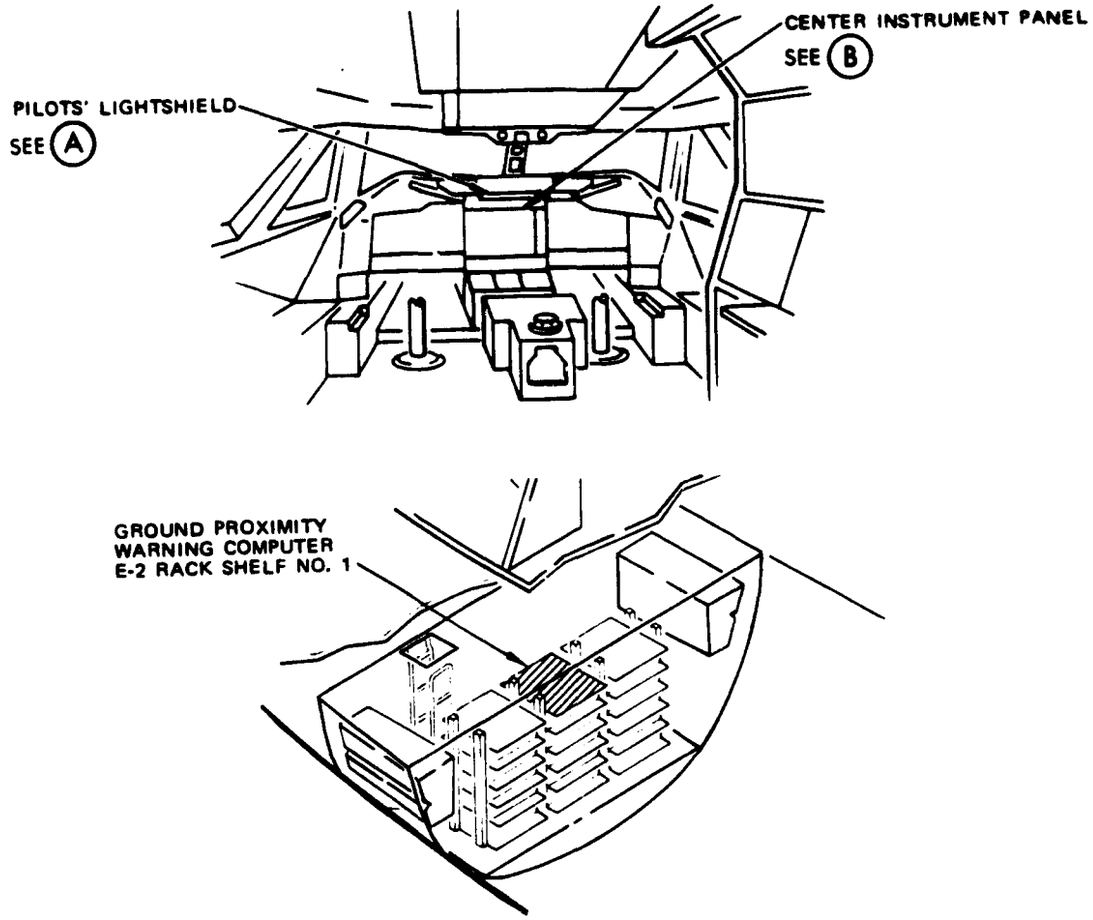

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FIGURE 1 (SHEET 2 OF 2) - GROUND PROXIMITY WARNING SYSTEM COMPONENT LOCATION

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A. The GPWS INHIBIT BELOW G/S pushbutton switch is located on the pilot's lightshield. It will inhibit the glide slope warning and cancels the advisory light when pressed.

7. N151UA-52UA: Monitor Light
   A. The monitor light, labeled GPWS INOP is located on the center instrument panel. The light comes on when the computer detects a fault within the computer.

8. Warning Speaker
   A. Aural Warning from the computer is audible through the control cabin interphone speakers, located on captain's and first officers' lower auxiliary panels. The speaker provides an aural indication that the GPWC has generated a warning of an unsafe flight path.

9. Operation
   A. Functional Description (Fig. 2 and 3)
      (1) The GPWS is operational when load control centers P7 and P12 are energized and CADC, GPWS, LRRA, VOR, GS, landing gear, inboard trailing edge flaps, interphone systems, and internal lighting system circuit breakers are closed.
      (2) Signal inputs to the GPWC consist of radio altitude information from LRRA No. 1, mach and altitude rate information from central air data computer No. 1. The radio altitude signal is a dc voltage which is a function of airplane height above ground level and is useful to approximately 2500 feet. The barometric rate signal is ac with a scale of 250 mv/1000 fpm altitude change. This rate signal is in phase with the 26-volt ac reference from the CADC during ascent and out-of-phase during descent. The glide slope deviation signal provides a low level input with a sensitivity of 75mv/deviation dot. The mach signal is a three wire synchro output calibrated from zero degrees for a 0.2 mach indication and increasing to one synchro revolution for a 1.2 mach indication.
      (3) Binary inputs to the GPWC consist of a landing gear and landing flap position signal and 28-volt dc radio altimeter valid, glide slope valid, and air data computer valid signals. The landing gear position signal is open when the landing gear is in any position other than down and locked and ground potential when the landing gear is down and locked. The landing flap position signal is ground potential when the flaps are not in landing range, and open when the flaps are in landing range.
      (4) The GPWC provides nine different voice messages. With the possibility of more than one warning occuring at the same time, the following priority has established with the associated modes. The highest priority message is always provided. If a higher priority warning occurs, the message will immediately switch to the higher priority message. If a higher priority warning stops, the high priority message will complete before switching to any lower priority message.

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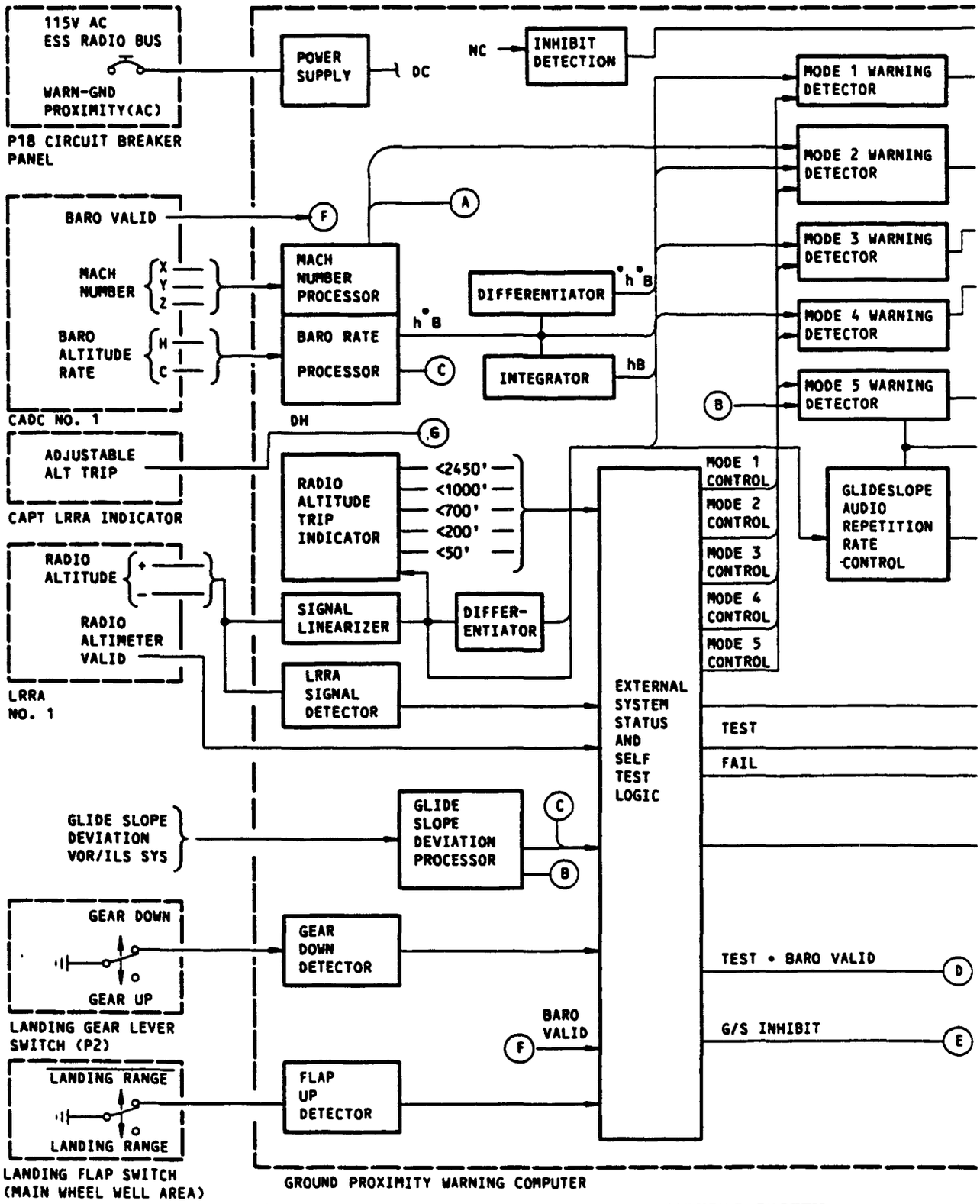

FIGURE 2 (SHEET 1 OF 4) - GROUND PROXIMITY WARNING SYSTEM BLOCK DIAGRAM

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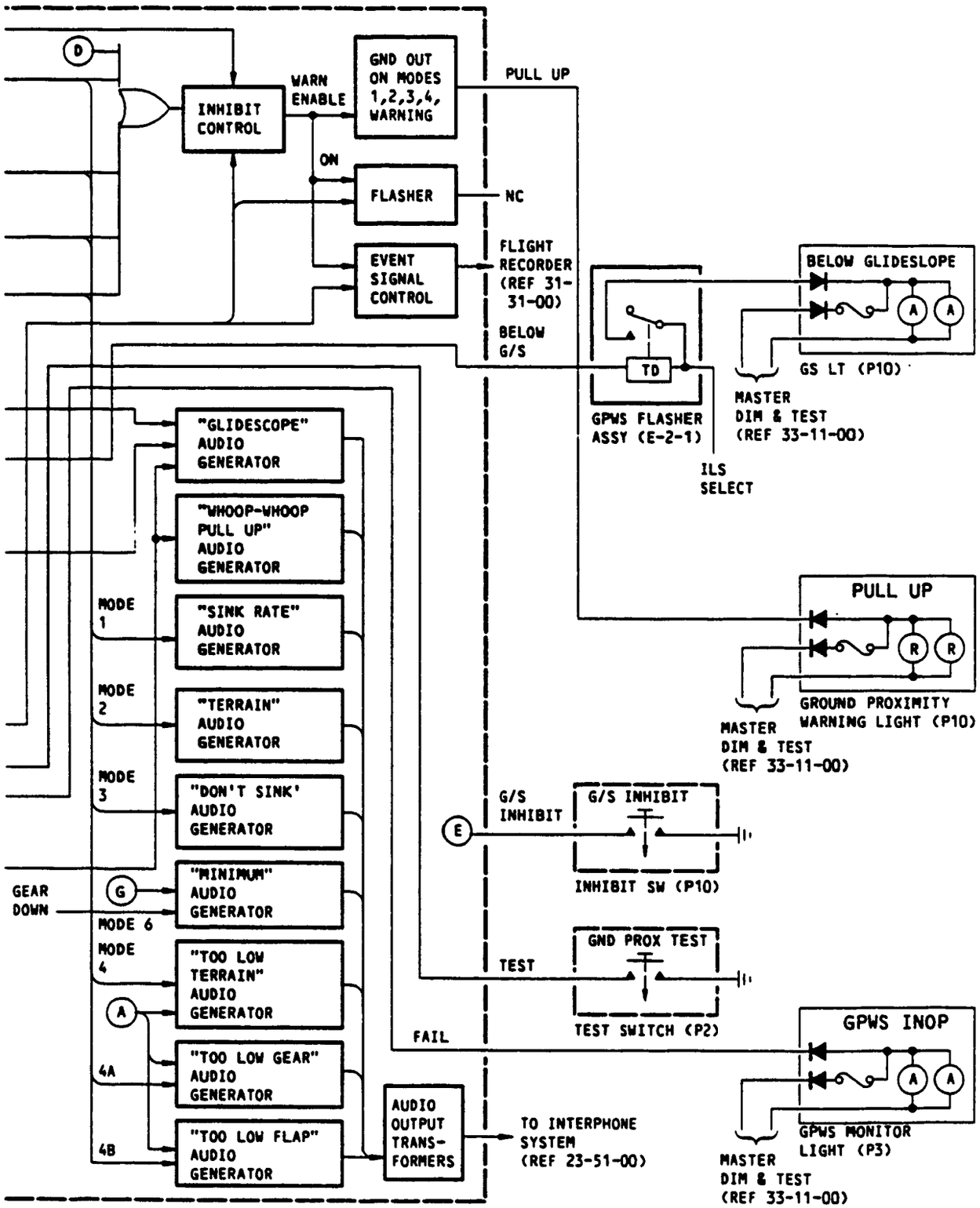

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FIGURE 2 (SHEET 2 OF 4) - GROUND PROXIMITY WARNING SYSTEM BLOCK DIAGRAM

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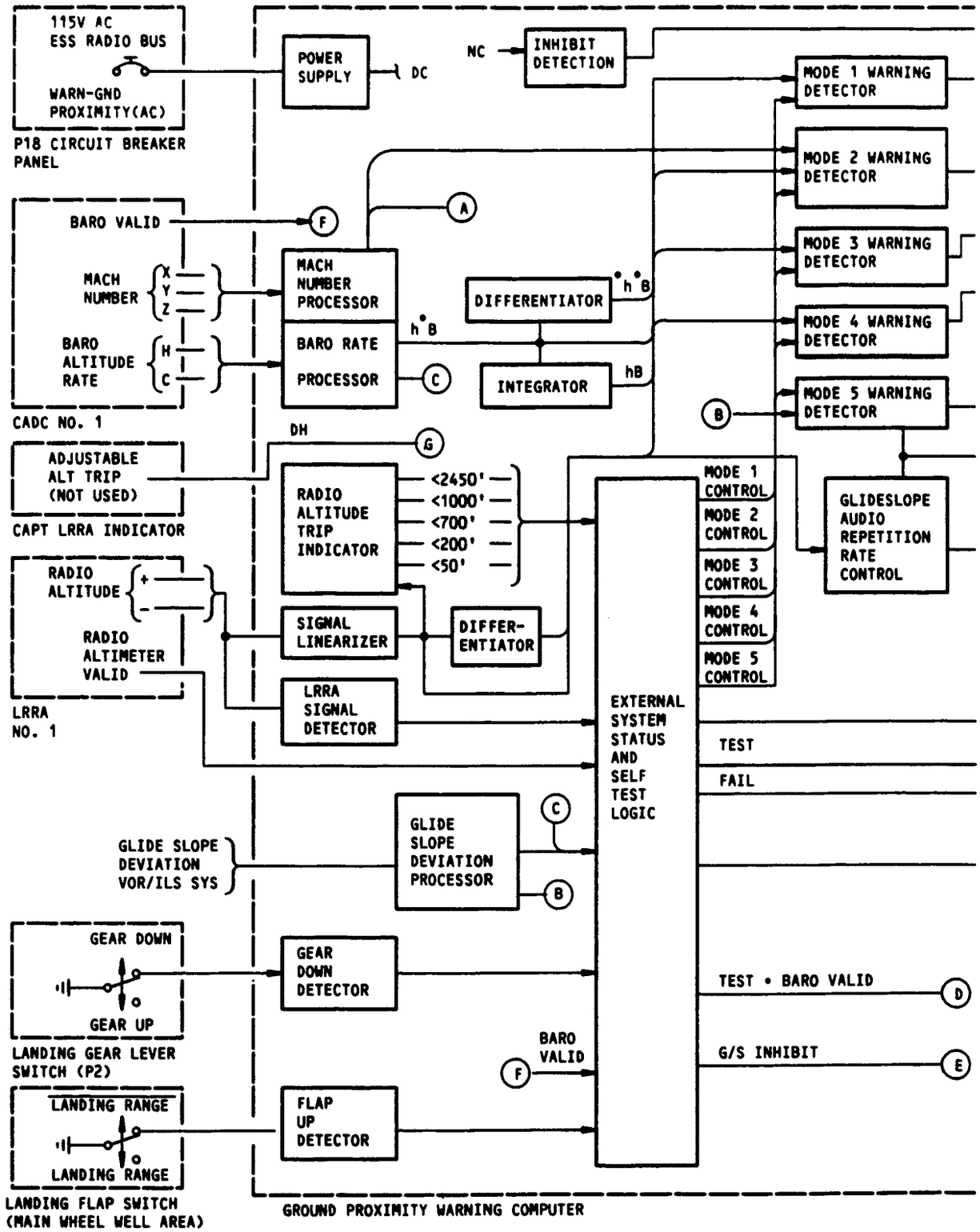

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FIGURE 2 (SHEET 3 OF 4) - GROUND PROXIMITY WARNING SYSTEM BLOCK DIAGRAM

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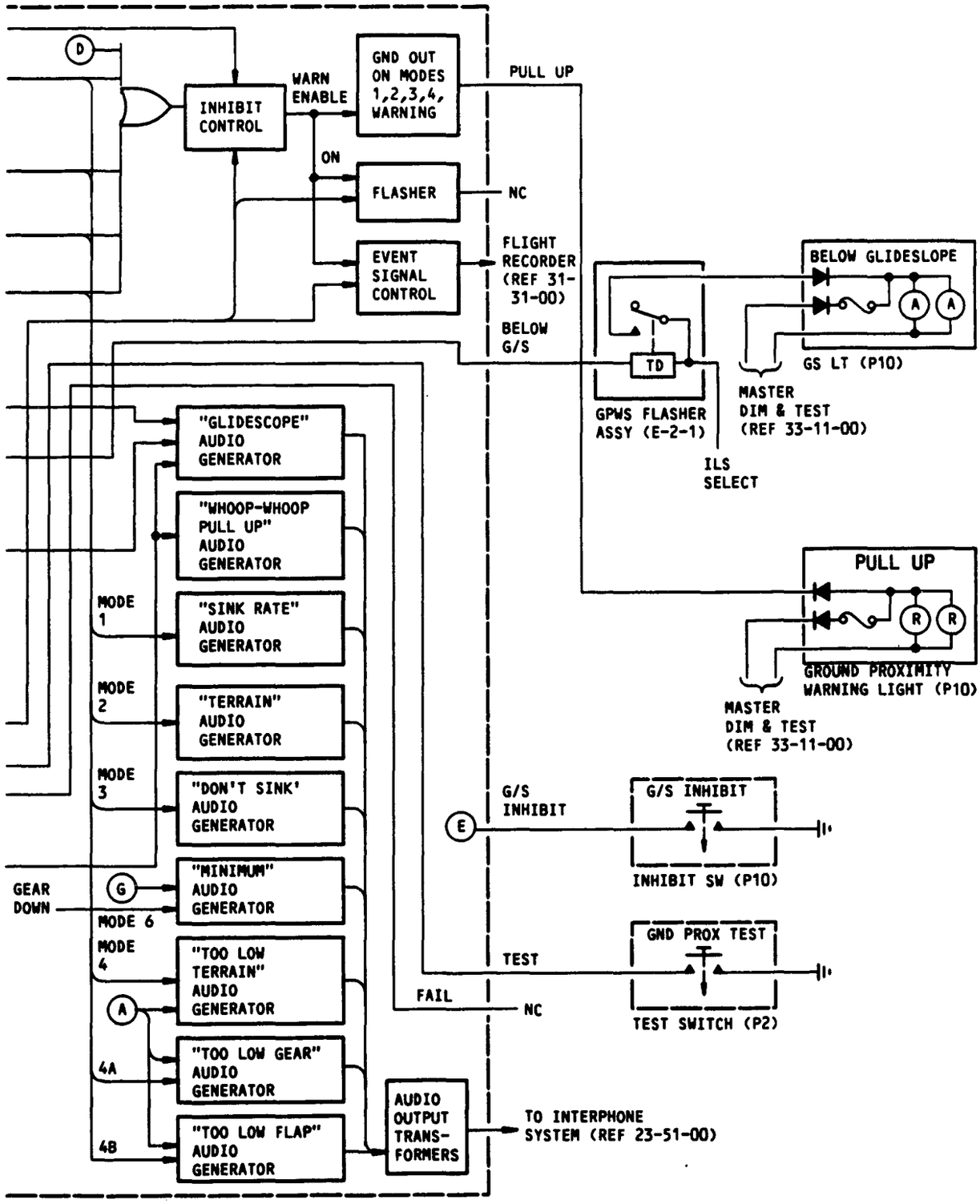

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FIGURE 2 (SHEET 4 OF 4) - GROUND PROXIMITY WARNING SYSTEM BLOCK DIAGRAM

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Priority	Message	Mode
1	WHOOP WHOOP PULL UP	1 and 2
2	TERRAIN	2
3	TOO LOW - TERRAIN	4
4	TOO LOW - GEAR	4A
5	TOO LOW - FLAPS	4B
6	MINIMUM	6
7	SINK RATE	1
8	DON'T SINK	3
9	GLIDE SLOPE	5

(5) The GPWC processes the input signals to provide warning outputs during the following flight conditions:

(a) Excessive sink rate warning (Mode 1)

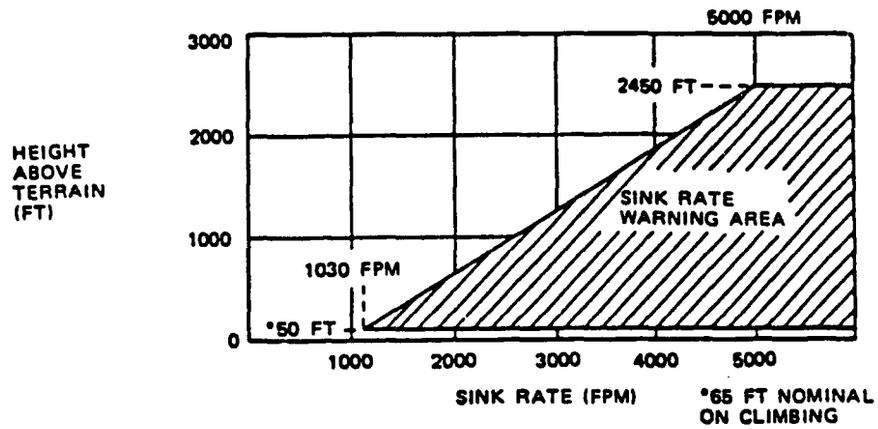
1) The computer provides the pilots with a warning if the airplane exceeds the barometric sink rate with respect to terrain clearance as shown in Fig. 3, Sheet 1. The warning may be visual and audible and is continuous while the airplane is within the warning area. The aural warning is SINK RATE, and is repeated every 1.5 seconds.

2) The aural warning changes to PULL UP if the airplane sink rate continuous and penetrated the warning area as shown in Fig. 3, Sheet 1. The PULL UP warning boundary is below the SINK RATE warning boundary.

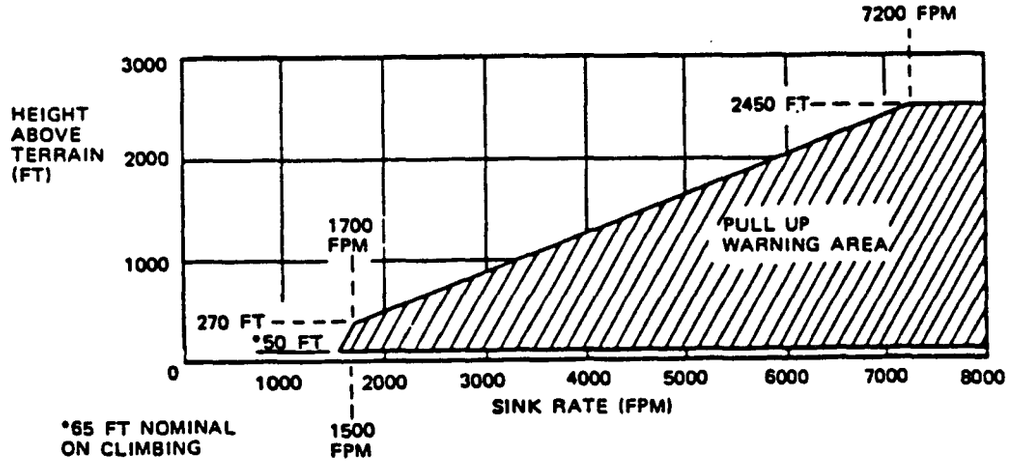
(b) Closure warning (Mode 2)

1) With the flaps not in landing configuration (airplane in cruise), the computer will provide the pilots with a warning if the airplane exceeds the terrain closure rates with respect to the terrain clearance shown in Fig. 3, Sheet 2. The PULL UP indicator and two cycles of aural TERRAIN come on. If the airplane remains within the curve boundary, the aural warning will change to PULL UP, repeated every 1.5 seconds. Upon leaving the curve boundary, due to either terrain change or pull up maneuver the aural warning will change to TERRAIN, repeated every 1.5 seconds. The warning will remain on until the barometric altitude has increased by 300 feet. During high speed operation, the upper curve boundary is increased lineraly between 0.35 and 0.45 mach to provide early warning.

2) With flaps in the landing configuration, the warning boundary is limited as shown in Fig. 3, Sheet 3. No altitude gain is required to turn off the TERRAIN aural warning after the PULL UP aural warning is activated. The PULL UP aural warning is inhibited at radio altitude below 700 feet with landing gears down. Only the TERRAIN aural warning is activated.

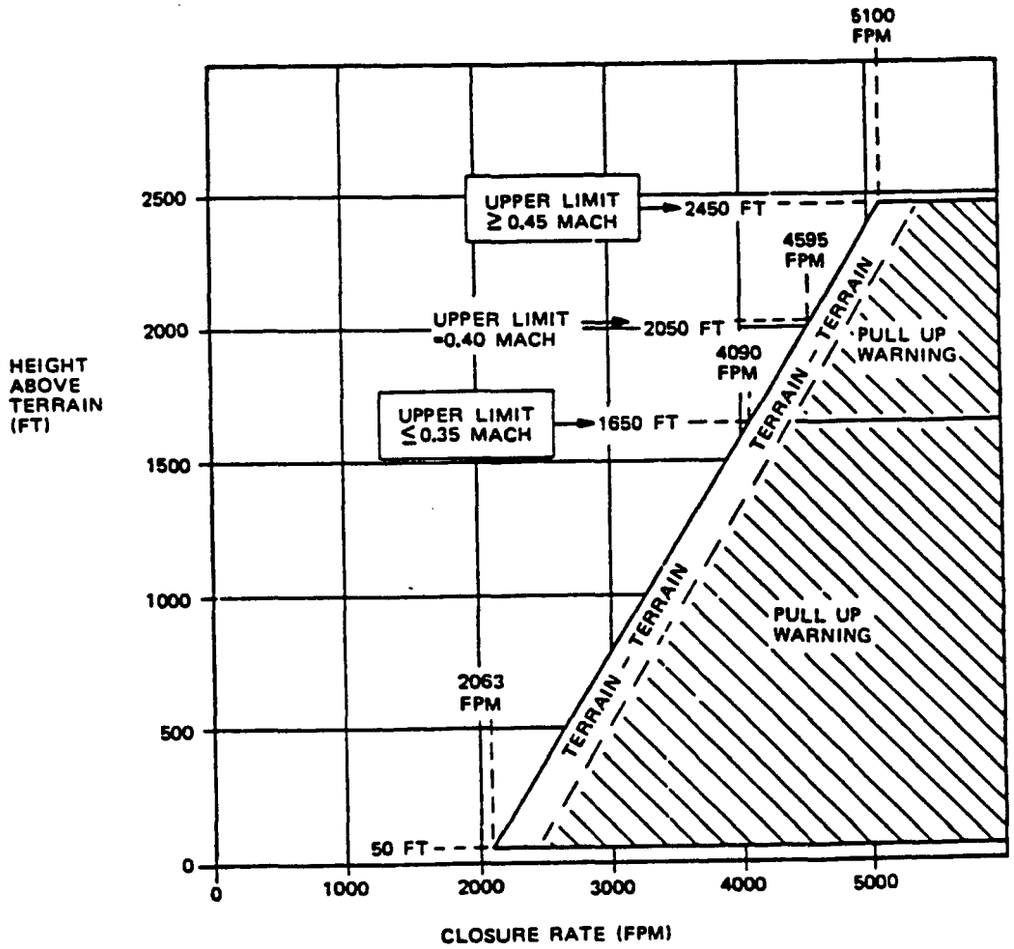


Mode 1 Sink Rate Envelope



Mode 1 Pull-Up Envelope

FIGURE FIGURE 3 (SHEET 1 OF 4) - GPWS WARNING CURVES



Mode 2A Warning Envelope Flaps Up

FIGURE FIGURE 3 (SHEET 2 OF 4) - GPWS WARNING CURVES

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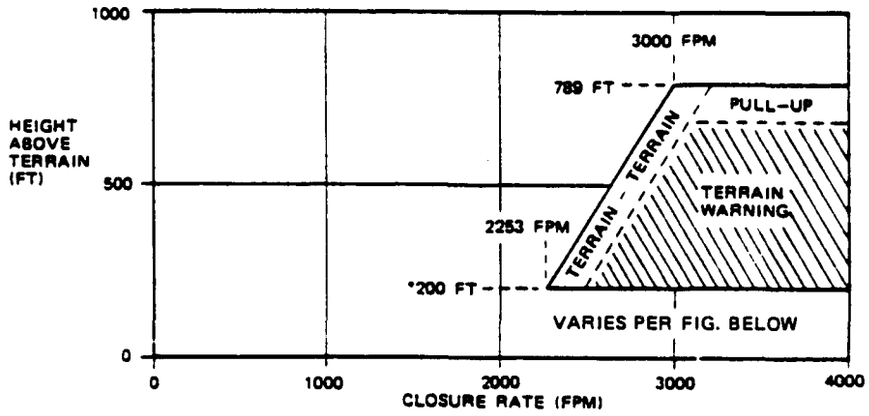
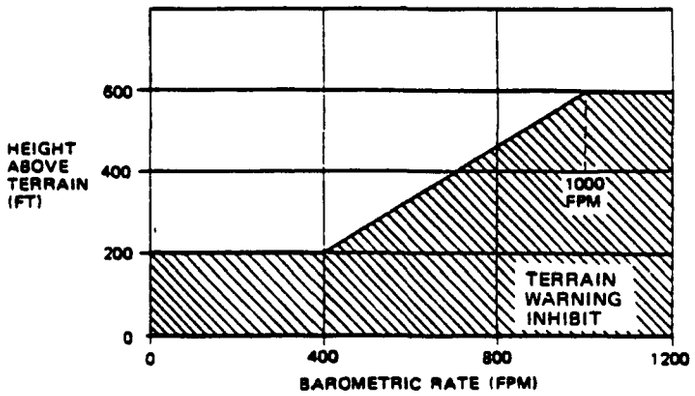
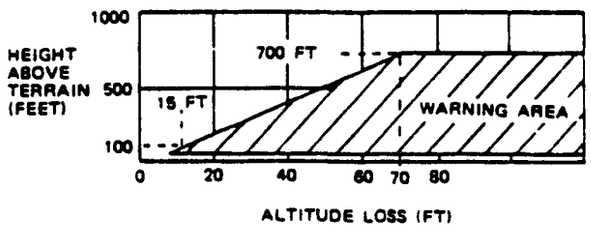


Mode 2B Warning Envelope Flaps Down

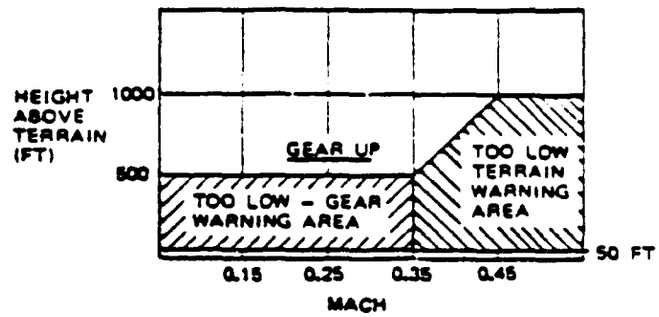


Mode 2B Lower Cutoff

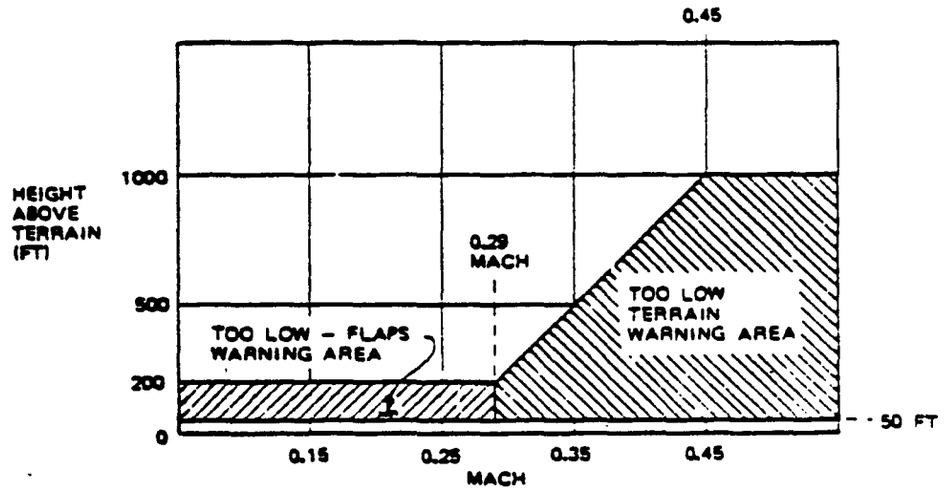


Mode 3 Warning Envelope

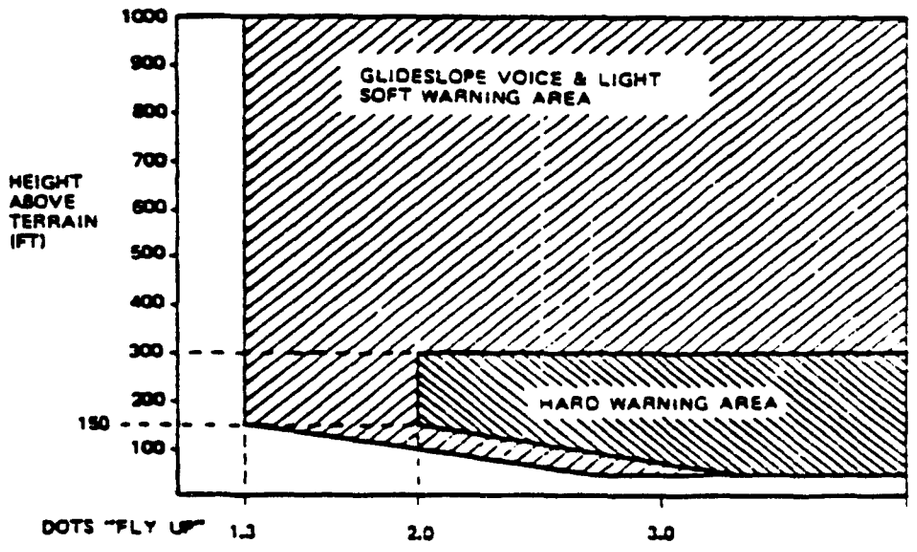
FIGURE FIGURE 3 (SHEET 3 OF 4) - GPWS WARNING CURVES



Mode 4-A Warning Envelope



Mode 4-B Warning Envelope



Mode 5 Warning Envelope

FIGURE FIGURE 3 (SHEET 4 OF 4) - GPWS WARNING CURVES

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3) To provide additional nuisance warning protection at the runway threshold during steeper approaches, the lower limit of mode 2B varies as a function of barometric rate as shown in Fig. 3, Sheet 3.

(c) Takeoff Altitude loss warning (Mode 3)

1) A warning consists of visual PULL UP and aural DON'T SINK is provided when the airplane is in takeoff mode before acquiring 700-foot terrain clearance with landing gear or flaps up and a barometric altitude loss is detected as shown in Fig. 3, Sheet 3. The altitude loss required to activate the warning varies with the height of the airplane above the ground at the time of inadvertent descent occurs. At a climbout altitude of 100 feet, any loss of altitude will activate the warning. At 700 feet, an altitude loss of 70 feet will activate the warning.

2) A magnetic latch provides logic between mode 3 and 4. During takeoff, the latch is set to arm the takeoff mode and disarming the terrain clearance warning. Upon acquiring 700 feet of altitude, the latch resets, arming the terrain clearance warning.

(d) Unsafe terrain clearance warning (Mode 4)

1) With landing gear not down, the computer will provide a warning if the airplane is below 500 feet and speed below 0.35 mach, as shown in Fig. 3, Sheet 4. The warning is visual and aural consists of TOO LOW-GEAR repeated every 1.5 seconds. For speed above 0.35 mach, the aural warning changes to TOO LOW-TERRAIN, repeated every 1.5 seconds and the warning threshold increases lineraly to a maximum of 1000 feet above the terrain.

2) With landing gear down, the minimum warning threshold decreases to 200 feet and a TOO LOW-FLAPS warning comes on if the flaps are not in landing configuration as shown in Fig. 3, Sheet 4. A magnetic latch is used to select mode 4A or mode 4B, so that power interruption or missed approach below 500 feet prevent reactivation of mode 4A until at least 700 feet of terrain clearance is reached.

(e) Glide slope deviation warning (Mode 5)

1) The glide slope warning is armed when an ILS frequency is selected. The warning envelope consists of two regions as shown in the Fig. 3, Sheet 4. The BELOW G/S indicators accompanied by a reduced volume of aural warning GLIDE SLOPE come on, if the deviation of the airplane below the glide slope exceeds 1.3 dots between 1000 and 150 feet of radio altitude. The aural warning increases to full volume if the deviations of the airplane below the glide slope exceeds 2 dots when the airplane is between 300 and 150 feet of radio altitude.

2) In order to allow the pilot to purposely descend below the glide slope without triggering a warning, the glide slope warning mode may be inhibited by pressing the BELOW G/S indicator when the radio altitude is below 1000 feet.

(f) Decision Height Warning (Mode 6).

1) With landing gear down, the computer will provide two cycles of MINIMUM aural warning when the airplane descends below the decision height (DH or MDA) set on the captain's LRRA indicator. The Mode 6 warning is not being used at this time on N158UA-65UA.

(6) System self-test may be initiated by pressing the GROUND PROXIMITY TEST switch. During self-test, the PULL UP, BELOW G/S indicators come on, and a loud GLIDE SLOPE and WHOOP WHOOP PULL UP aural warning occurs. The PULL UP aural warning may repeat up to seven times.

B. Controls

(1) The GROUND PROX WARN CMPTR circuit breaker on electronic circuit breaker panel P7 controls the 115-volt ac power to the computer. The ground proximity warning system operates continuously whenever the essential instrument bus is energized.

(2) System control includes the ground proximity warning system test switch and the glide slope inhibit switch.

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GROUND PROXIMITY WARNING SYSTEM - TROUBLE SHOOTING

1. General
   A. The following trouble shooting procedures are based on performance of the system operational test and are presented in tree-type format. The test steps (heavy-line boxes) are connected by shaded arrows to show the OK condition path. When all steps in the OK condition path check out, the system is operable.
   B. When a test step does not check out, follow the NOT OK line to the box containing the trouble symptom. Turn to the procedure indicated and continue to follow a single line by analyzing the results of each test step until the required corrective action is determined. Perform the specified corrective action; then repeat the step at which the failure was encountered.
   C. All trouble shooting procedures are based on the assumption that wiring is OK and that electrical power is available. If the corrective action in the procedure does not correct the problem, check wiring using the wiring diagram.

2. Prepare for Trouble Shooting
   A. Verify that GROUND PROX WARN CMPTR; CADC 1 PWR, SYNC EXCIT, and ALTIM IND 1; ALTIM LOW 1; VOR/GS circuit breakers on panel P7 are closed.
   B. Verify that pilots' IND LTS circuit breaker on panel P12 is closed.
   C. Apply electrical power (Ref 24-22-00).
   D. Verify that cockpit interphone speakers are operating (Ref 23-51-00).
   E. Select an ILS frequency on VHF-1 (Ref 34-31-00).
   F. Verify that failure warning flag in captain's height indicator and altitude indicator are not in view.
   G. Verify that inboard trailing edge flaps are less than 20 degrees.
   H. Verify that landing lever is set at DN or OFF position.

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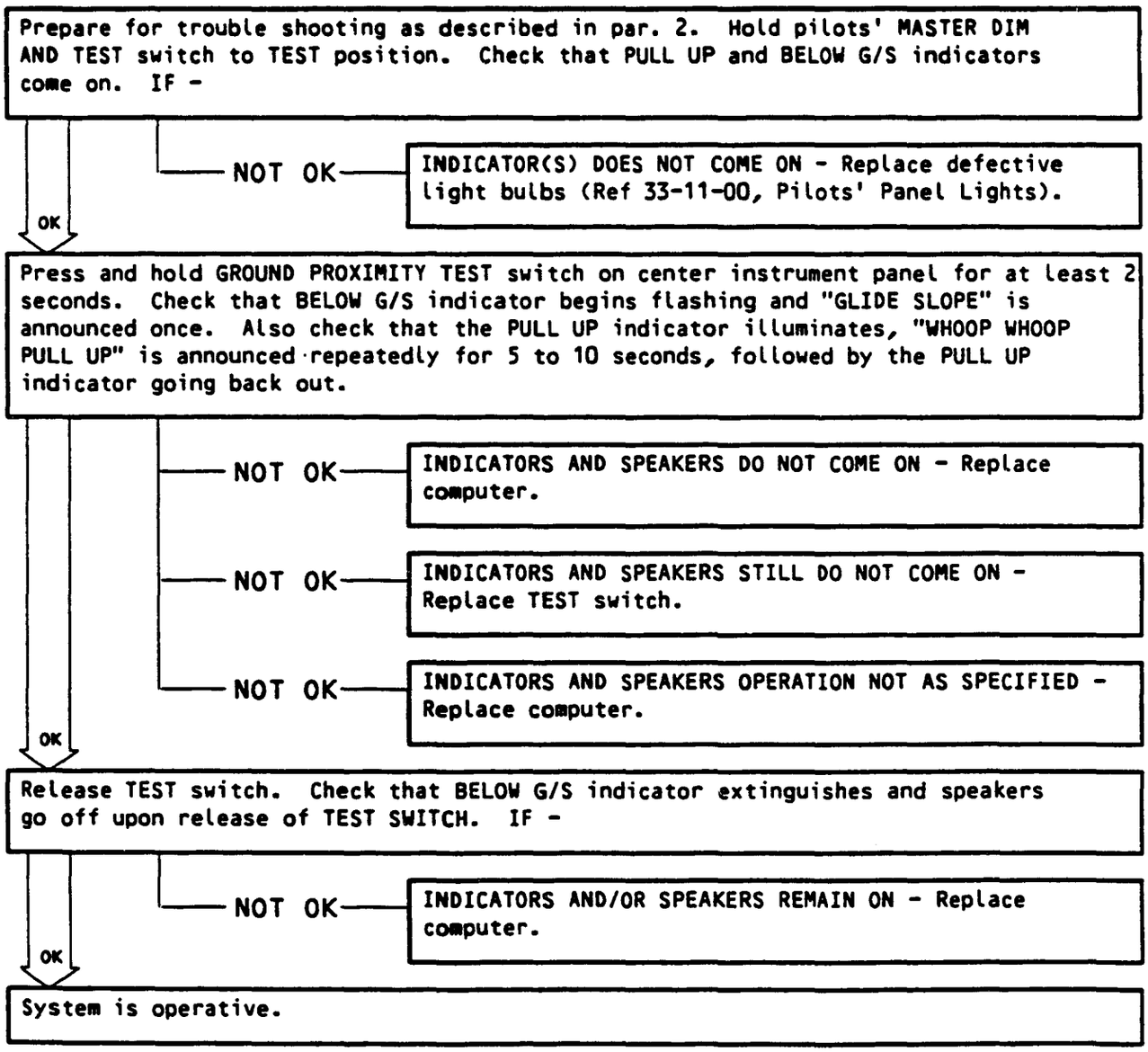
Prepare for trouble shooting as described in par. 2. Hold pilots' MASTER DIM AND TEST switch to TEST position. Check that PULL UP and BELOW G/S indicators come on. IF -
NOT OK
INDICATOR(S) DOES NOT COME ON - Replace defective light bulbs (Ref 33-11-00, Pilots' Panel Lights).
OK
Press and hold GROUND PROXIMITY TEST switch on center instrument panel for at least 2 seconds. Check that BELOW G/S indicator begins flashing and "GLIDE SLOPE" is announced once. Also check that the PULL UP indicator illuminates, "WHOOP WHOOP PULL UP" is announced repeatedly for 5 to 10 seconds, followed by the PULL UP indicator going back out.
NOT OK
INDICATORS AND SPEAKERS DO NOT COME ON - Replace computer.
NOT OK
INDICATORS AND SPEAKERS STILL DO NOT COME ON - Replace TEST switch.
NOT OK
INDICATORS AND SPEAKERS OPERATION NOT AS SPECIFIED - Replace computer.
OK
Release TEST switch. Check that BELOW G/S indicator extinguishes and speakers go off upon release of TEST SWITCH. IF -
NOT OK
INDICATORS AND/OR SPEAKERS REMAIN ON - Replace computer.
OK
System is operative.

TMA 85555/F/2246R

END

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GROUND PROXIMITY WARNING SYSTEM - ADJUSTMENT/TEST

1. General
   A. The operational test and system test are intended to check out the overall function of the ground proximity warning system (GPWS). The operational test is self-contained and gives a confidence test of the system, utilizing on-board equipment. The system test is predicated on successful completion of the operational test and cannot be performed alone.
2. Referenced Procedures
   A. 23-51-00, Adjustment/Test
   B. 24-22-00, Maintenance Practices (Apply Power)
   C. 34-11-00, Maintenance Practices (Pressurization)
   D. 34-12-00, Adjustment/Test
   E. 34-31-00, Adjustment/Test
   F. 34-33-00, Adjustment/Test
3. Operational Test
   A. Prepare for Test
      (1) Verify that GROUND PROX WARN CMPTR, CADC 1, ALTM LOW 1, VOR-1 AC, VOR-1 DC, GS-1, Main interphone, Captain's interphone, F/O interphone, and internal lighting system circuit breakers are closed.
      (2) Provide electrical power (Ref 24-22-00).
      (3) Verify that VHF-1 is tuned to an ILS frequency (Ref 34-31-00).
      (4) Verify that cockpit interphone system is operating (Ref 23-51-00).
      (5) Verify that landing gear selector is in DN position.
      (6) Verify that inboard trailing edge flaps are in 20 degrees or less.
   B. Test System
      (1) Press and hold GROUND PROXIMITY TEST switch. Check that BELOW G/S indicator flashes and GLIDE SLOPE aural warning is announced once. Check that the PULL UP indicator illuminates and WHOOP WHOOP PULL is announced repetatively for 5 to 10 seconds, after which the PULL UP indicator shall extinguish.
      (2) Release the GROUND PROXIMITY TEST switch and check that the BELOW G/S indicator turns off.

          NOTE: Allow at least 30 seconds for circuits to stabilize before repeating test.

      (3) Remove electrical power if no longer required (Ref 24-22-00).
4. System Test
   A. Equipment and Materials
      (1) Pitot-static test set, probe adapter and gages (Ref 34-11-00)
      (2) LRRA Altitude Simulator
      (3) Signal Generator, Collins 479T-2 or equivalent
   B. Prepare to test
      (1) Set up pitot-static test set and adapter to captain's pitot-static system (Ref 34-11-00), such that predetermined altitude rates from No. 1 CADC may be obtained (Ref 34-12-00).
      (2) Set up LRRA altitude simulator such that radio altitude from No. 1 LRRA may be set and varied.

(3) Set up signal generator such that glide slope deviation signals may be set and varied.
(4) Ensure that movement of landing gear selector lever will not result in movement of landing gear.

CAUTION: ALL LANDING GEAR GROUND LOCKS MUST BE INSTALLED. THERE MUST BE NO PRESSURE ON ANY OF FOUR HYDRAULIC SYSTEMS. NO ATTEMPT SHALL BE MADE TO DISTURB FLAG IN LANDING GEAR HANDLE AND NO ATTEMPT SHALL BE MADE TO MOVE HANDLE INTO UP POSITION.

(5) Ensure that trailing edge flaps and drive system are correctly installed and rigged, ready for actuation.

CAUTION: ENSURE THAT GROUND EQUIPMENT IS OUT OF FLAP TRAVEL; THAT ALL PERSONNEL SAFETY PRECAUTIONS AND WARNINGS ARE IN EFFECT.

C. Test System
(1) Perform Operational Test. Leave power on.
(2) In-flight Self-Test
(a) Set landing gear selector to OFF.
(b) Set inboard trailing edge flaps to 20 degrees or less.
(c) Set CADC No. 1 altitude rate to 0 feet per minute, and radio altitude to 1200 feet.
(d) Press and hold GROUND PROXIMITY TEST SWITCH. Check that PULL UP indicator comes on, BELOW G/S indicator comes on flashing GLIDE SLOPE aural warning occurs once, and WHOOP WHOOP PULL UP aural warning repeats until the test switch is released.
(3) Test Take Off Descent Warning
(a) Set landing gear selector to DN position and simulate a radio altitude of 0 feet for at least 2 seconds.
(b) Using pitot static test set, set an altitude such that a descent rate of 300 feet per minute may be maintained.
(c) Verify that inboard trailing edge flaps are set at 20 degrees.
(d) Verify that VHF NAV No. 1 is tuned to a VOR frequency.
(e) Set landing gear selector to OFF position and simulate a 200 feet radio altitude.
(f) Simulate a barometric altitude sink rate of 300 feet per minute. Check that PULL UP indicator illuminates and DON'T SINK aural warning is actuated following a delay of approximately 5 seconds.
(g) Set an ascent rate of 300 feet per minute for CADC No. 1. Check that GPWS warning goes off.
(h) Reset barometric sink rate to 300 feet per minute. Check that GPWS warnings come on.
(i) Increase radio altitude to 1200 feet. Check that warnings go off within 3 seconds (at approximately 700 feet).
(4) Test Terrain Clearance
(a) Verify that CADC No. 1 altitude rate is set at 0 feet per minute.

(b) Set radio altitude to 1200 feet.
(c) Verify that landing gear selector is set at OFF position.
(d) Verify that inboard trailing edge flaps are set at 20 degrees.
(e) Verify that VHF NAV No. 1 is tuned to a VOR frequency.
(f) Set CADC No. 1 mach number to 0.45 or greater.
(g) Decrease radio altitude slowly (less than 2000 feet per minute) until PULL UP indicator illuminates and TOO LOW TERRAIN aural warning is announced. Check that warnings come on at about 1000 feet.
(h) Continue to decrease the radio altitude slowly to 600 feet. Check that warnings do not go off.
(i) Decrease mach number until warnings extinguish. Check that mach number is between 0.32 and 0.42.
(j) Decrease mach number to 0.2 and check that warnings remain off.
(k) Decrease radio altitude slowly until PULL UP indicator comes on and TOO LOW GEAR aural warning is announced. Check that warnings come on at about 500 feet.
(l) Set landing gear selector to DN position. Check that GPWS warning goes off.
(m) Decrease radio altitude. Check that PULL UP indicator illuminates and TOO LOW FLAPS aural warning is actuated at approximately 200 feet.
(n) Set inboard trailing edge flaps to 25 degrees or more. Check that GPWS warning goes off.

(5) Test Excessive Sink Rate Warning
(a) Using pitot static test set, set barometric altitude such that a descent rate of 5000 ± 500 feet per minute may be initiated.
(b) Simulate a 2200 feet radio altitude.
(c) Verify that landing gear selector is set at OFF.
(d) Verify that inboard trailing edge flaps are set at 20 degrees.
(e) Simulate a barometric altitude sink rate of 5000 ± 500 feet per minute. Check that PULL UP indicator illuminates and SINK RATE aural warning is actuated.
(f) Decrease radio altitude slowly. PULL UP indicator shall remain illuminated and WHOOP WHOOP PULL UP aural warning is actuated.
(g) Return sink rate to 0 feet per minute. Check that GPWS warning goes off.

(6) Test Closure Warning
(a) Simulate a radio altitude of 2500 feet.
(b) Verify that landing gear selector is set to OFF.
(c) Verify that inboard trailing edge flaps are set at 20 degrees or less.
(d) Set CADC No. 1 barometric altitude rate to 0 feet per minute and mach number to 0.25 or less.

(e) Rapidly reduce simulated radio altitude at a rate between 2800 and 4000 feet per minute.

NOTE: This may be accomplished by reducing radio altitude from 2200 feet to 600 feet in approximately 30 seconds, as smoothly as possible.

(f) Check that PULL UP indicator illuminates, TERRAIN-TERRAIN aural warning is announced once, and WHOOP WHOOP PULL UP aural warning is actuated.

NOTE: The radio altitude is not to be reduced to less than 550 feet for this test.

(g) When radio altitude is decreased to about 600 feet, it is stopped and held constant. Check that the WHOOP WHOOP PULL UP aural warning ceases and that TERRAIN aural warning is repeated at 0.75 second intervals.

(h) Set CADC No. 1 altitude rate for ascent at 3000 feet per minute. Check that TERRAIN audio is deactivated in approximately 6 seconds.

(7) Test Glide Slope Deviation Warning

(a) Verify that VHF NAV No. 1 is tuned to an ILS test frequency, and the glide slope pointer stays in center position.

(b) Verify that landing gear selector is in DN position.

(c) Verify that inboard trailing edge flaps are extended more than 25 degrees.

(d) Simulate a radio altitude of 1200 feet.

(e) Verify that CADC No. 1 altitude rate is set at 0 feet per minute.

(f) Apply a more than 2-dot fly up glide slope (GS) deviation signal. Refer to 34-31-00.

(g) Check that no warning occurs.

(h) Reduce radio altitude to 600 feet. Check that BELOW G/S indicator light comes on flashing and a soft GLIDE SLOPE aural warning comes on at a repetition rate of approximately once every 2 to 3 seconds.

NOTE: The BELOW G/S indicator light comes on flashing and GLIDE SLOPE voice warning are referred to as G/S warning from here on.

(i) Set barometric sink rate to 3500 feet per minute. Check that GLIDE SLOPE audio warning ceases, the PULL UP indicator illuminates, and WHOOP WHOOP PULL UP audio warning is actuated.

(j) Set barometric sink rate to 0 feet per minute. Check that PULL UP visual and aural warnings cease and GLIDE SLOPE audio warning is reactivated.

(k) Reduce GS deviation to 0 dot (center). Check that G/S warning goes off.

(l) Reduce radio altitude to 250 feet and slowly increase GS deviation signal. Check that G/S warning comes on between 1 and 1-1/2-dot fly up deviation.
(m) Further increase GS deviation signal. Check that G/S warning comes on between 1-3/4 and 2-1/4-dot fly up deviation with a hard (high level) voice at a repetition rate approximately once every 1-1/2 seconds.
(n) Slowly reduce GS deviation signal. Check that G/S warning reduces in volume between 1/4 and 1/2 dot less than indication of step (m).
(o) Slowly reduce GS deviation signal. Check that G/S warning goes off between 1/4 and 1/2 dot less than indication of step (l).
(p) Reduce radio altitude to 120 feet. Increase GS deviation signal to 2-dot fly up.
(q) Check that G/S warning comes on with a soft voice between 1-1/2 to 2-dot fly up at a repetition rate of approximately once every 1-1/2 seconds.
(r) Momentarily press INHIBIT BELOW G/S switch located on pilot's lightshield. Check that G/S warning goes off.

(8) N151UA-52UA: Test decision height warning.
(a) Using pitot static test set, set an altitude such that an ascent rate of 300 feet per minute may be maintained.
(b) Simulate a 0 feet radio altitude for a minimum of 2 seconds.
(c) Verify that inboard trailing edge flaps are set at 20 degrees.
(d) Verify that VHF NAV No. 1 is tuned to a VOR frequency.
(e) Verify that landing gear selector is in down position.
(f) Set decision height to 500 feet.
(g) Set landing gear selector to OFF POSITION.
(h) Increase radio altitude slowly (approx. 300 feet per minute) to 600 feet and then decrease it to 400 feet. Check that no audio is announced.
(i) Set landing gear selector to down position.
(j) Set inboard trailing edge flaps to 25 degrees.
(k) Set radio altitude to 1200 feet.
(l) Simulate a barometric descent rate of approximately 300 feet per minute.
(m) Decrease radio altitude to 450 feet, MINIMUMS aural warning will be announced twice.
(n) Set decision height to 300 feet.
(o) Decrease radio altitude to 250 feet, check that GPWS warnings remain off.

(9) Restore airplane to normal
(a) Slowly relieve pitot static system and remove test adapters. Refer to 34-11-00 and 34-12-00.
(b) Reset radio altitude to normal and disconnect test simulator. Refer to 34-33-00.
(c) If no longer required, remove electrical power. Refer to 24-22-00.
(d) Reset VOR/ILS system to normal. Refer to 34-31-00.

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UNITED AIRLINES

VENDOR/UA CROSS REFERENCE SUPPLEMENT

VENDOR PART NUMBER	UA STOCK STATUS

EQUIPMENT AND MATERIALS

(1) Pitot-static test set, probe adapter and gages (Ref 34-11-00)
LOCAL SUPPLY

(2) LRRA Altitude Simulator
LOCAL SUPPLY

(3) Signal Generator, Collins 479T-2 or equivalent
SFOOV

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GROUND PROXIMITY WARNING COMPUTER - REMOVAL/INSTALLATION

1. Referenced Procedures
   A. 23-51-00, Adjustment/Test
   B. 24-22-00 Maintenance Practices (Apply Power)

2. Remove Ground Proximity Warning Computer
   A. Open GROUND PROX WARN CMPTR circuit breaker on panel P7.
   B. Gain access to main equipment center.
   C. Remove computer from shelf.

3. Install Ground Proximity Warning Computer
   A. Install computer on shelf.
   B. Close circuit breaker opened in step 2A.
   C. Test computer.
      (1) Provide electrical power (Ref 24-22-00).
      (2) Verify that CADC 1 PWR and SYNC EXCIT; ALTIM LOW 1 circuit breakers on panel P7, and pilots' IND LTS circuit breakers on panel P12 are closed.
      (3) Verify that cockpit interphone system is operating (Ref 23-51-00).
      (4) Computer Test
         (a) Press and hold TEST switch on computer.
         (b) Check that fault indicator lamps on computer comes on flashing momentarily.
         (c) Check that mode annunciators on computer display white in sequence.
         (d) Check that GPWC OK light on computer comes on flashing momentarily.
         (e) Return system to normal, and disconnect electrical power if no longer required.

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GROUND PROXIMITY/WINDSHEAR WARNING SYSTEM - ADJUSTMENT/TEST

1. General
   A. The MARK VII GPWS warning system provides the pilot with aural and visual warnings of a potentially dangerous flight path relative to the ground and windshear conditions.
   B. The MARK VII warning computer generates warning based on information received from several sensors. This information can be either digital or analog form. Inputs required for warning Modes 1-7 are as follows:
      (1) Altitude above ground level
      (2) Barometric Altitude Rate
      (3) Barometric Altitude
      (4) Glideslope Deviation
      (5) Airspeed
      (6) Pitch and Roll Attitude
      (7) Longitudinal and Normal Acceleration
      (8) Angle of Attack
      (9) Flap and Gear Position
      (10) Static Air Temperature

2. Referenced Procedures
   A. WD 34-46-11, Page 1 GPWS, Wiring Diagram
   B. WD 34-19-11, Page 1 - WINDSHEAR, Wiring Diagram

3. Adjustment/Test
   A. General
      (1) The Mark VII Self-Test is divided into four sections which must be preformed in consecutive order. The level I test must be completed before level II test can start. The self-test is initiated by depressing the GPWS WARNING LIGHT for a minimum of FIVE (5) seconds.
      (2) Each self-test level is briefly described following:
         (a) LEVEL I - (present status test) - This is the normal pre-takeoff test performed by the flight crew.
         (b) LEVEL II - (Maintenance test) - This test is done by maintenance personnel and is used to help resolve system faults.
         (c) LEVEL III - (flight history) - This test will annunciate faults and warning occurrences that have happened during past flights. This information id used to resolve system problems reported by the flight crew.
         (d) LEVEL IV (configuration test) - This test is used to indicate configuration status of the installation, the Warning Computer and associated software programs.

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B. Test

(1) Press the GPWS WARN Light, and hold for a minimum of 5 seconds, to initiate LEVEL I test and verify the following:

(a) System Response	Function Tested
GPWS and WS INOP Lamps on	Self-Test Started
GSA Lamps on	Below Glideslope
"GLIDESLOPE-GLIDESLOPE" Warning Voice active	
GSA Lamps off	
GPWS Warning Lamps on	Ground Proximity
"WHOOP-WHOOP-PULL UP" Warning Voice active	
GPWS Warning Lamps off	
Windshear Warning Lamps on	Windshear Detection
"WINDSHEAR-WINDSHEAR-WINDSHEAR" WARNING Voice active	
Windshear Warning Lamp off	
GPWS and WS INOP Lamps off	Self-Test complete

1) A system with internal faults, external wiring faults, or signal faults currently detected will generate various responses other than those detailed preceding when a level I Self-Test is initiated. The following table lists the system responses and the appropriate action to take.

(b) System Response	Action
"SYSTEM INOP" Voice and only GPWS and WS INOP Lamps on	Isolate Fault with LEVEL II test
"GLIDESLOPE INOP" Voice and no GSA Lamp	Isolate Fault with Level II test

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System Response	Action (Continued)
"GLIDESLOPE-GLIDESLOPE" voice and no GSA Lamps	Lamp, Wiring, or Unit fault
"WHOOP-WHOOP PULL UP" voice and no GPWS Warning Lamp	Lamp, Wiring, or Unit fault
"WINDSHEAR INOP" voice and no Windshear Warning Lamps	Isolate Fault with LEVEL II test
"WINDSHEAR-WINDSHEAR-WINDSHEAR" voice and no Windshear Warning Lamp	Lamp, Wiring, or Unit fault
GPWS and/or WS INOP lamp not on during LEVEL I test	Lamp, Wiring, or Unit fault
No voices	Speaker, Wiring, or Unit fault

(2) Within 3 seconds of the completion of LEVEL I test, press the GPWS WARN Light, and hold for a minimum of 5 seconds, to initiate LEVEL II test and verify the following:

"NO FAULTS" is annunciated

If one or more faults exist, then one or more annunciations describing the fault will be heard. Each fault and the corresponding sensor/wiring subsystem detected as failing is listed in the following table:

(a) Fault Voice Message	Indicated Subsystem
Warning Computer Fault	MK-VII Warning Computer
Program Pins Changed Program Pins Wiring Faults	Program Pin Wiring or MK-VII computer

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Fault Voice Message	Indicated Subsystem (Continued)
Radio Altitude Fault Radio Altitude Wiring Fault	Radio Altimeter or Wiring
Baro Rate One Fault Baro Altitude Rate One Wiring Fault Baro Altitude One Fault Baro Altitude One wiring Fault	Number 1 Air Data Computer
Glideslope Fault Glideslope Wiring Fault Glideslope Cancel Switch Fault	VHF Navigation Receiver
Normal Accelerometer One Fault Normal Accelerometer One Wiring Fault	GPWS Accelerometer
Longitudinal Accelerometer One Fault Longitudinal Accelerometer One Warning Fault	GPWS Accelerometer
Height Rate One Fault Height Rate One Wiring Fault	INS Computer No. 1
Airspeed One Fault Airspeed One Wiring Fault	Number 1 Air Data Computer
Pitch One Fault Roll One Fault Pitch One Wiring Fault Roll One Wiring Fault Pitch Rate One Fault Roll Rate One Fault Pitch Rate One Wiring Fault Roll Rate One Wiring Fault	INS Computer No. 1
Flap Switch Fault	Flap Position Switch

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Fault Voice Message	Indicated Subsystem (Continued)
Gear Switch Fault	Gear Position Switch
INOP Switch Fault	Self-Test Switch
Air Temp One Fault Air Temp One Wiring Fault	Number 1 Air Data Computer
Left Angle of Attack Fault Left angle of Attack Wiring Fault	Left AOA Sensor
Left Flap Angle Fault Left Flap Angle Wiring Fault	Left Flap Sensor
Coarse Baro Altitude One Fault Coarse Baro Altitude One Wiring Fault	Number 1 Air Data Computer

(3) Within 3 seconds of the completion of LEVEL II test, press the GPWS WARN Light, and hold for a minimum of 5 seconds, to initiate LEVEL III test and verify the following:

"NO FLIGHT HISTORY" is annunciated

If one or more faults and/or warnings have occurred in the last 64 flights, then that fault and/or warning will be annunciated. After the fault or warning is annunciated the flight number(s) in which it occurred will be annunciated. The most recent flight leg is indicated as "FLIGHT ONE" and the sixty-fourth most recent flight leg is indicated as "FLIGHT SIXTY-FOUR". The faults that are annunciated during the LEVEL III test are the same as those annunciated during the LEVEL II test and are detailed preceding. The warnings annunciated during the LEVEL III tests are listed following.

(a)

Warning History Message	Warning Mode
Sinkrate Warning	Mode 1 Sinkrate Warning
Pull-up Warning One	Mode 1 Pull-up Warning
Pull-up Warning Two	Mode 2 Pull-up Warning

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Warning History Message	Warning Mode (Continued)
Terrain Warning	Mode 2 Terrain Warning
Don't Sink Warning	Mode 3 Don't Sink
Too Low Terrain Warning 4A	Mode 4A Too Low Terrain
Too Low Terrain Warning 4C	Mode 4C Too Low Terrain
Too Low Gear Warning	Mode 4A Too Low Gear Warning
Too Low Flaps Warning	Mode 4B Too Low Flap Warning
Glideslope Caution	Mode 5 Soft Glideslope Warning
Glideslope Warning	Mode 5 Hard Glideslope Warning
Windshear Caution	Windshear Warning
Windshear Warning	Windshear Warning
Bank Angle Warning	Bank Angle Warning

(4) Within 3 seconds of the completion of LEVEL III test, press the GPWS WARN Light, and hold for a minimum of 5 seconds, to initiate LEVEL IV test and verify the following configuration information:

"PROGRAM PINS F0184016"
"PROGRAM MODULE VERSION XX.XX"
"DATA MODULE VERSION XX.XX"
"WARNING COMPUTER PROGRAM VERSION "XX.XX"
"WARNING COMPUTER VERSION XX.XX.XX"

NOTE: XX.XX.XX is the current program or version and will change frequently.

TMA 2505/C/6423R

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GROUND PROXIMITY WARNING SYSTEM - MINIMUM PERIODIC CHECK

1. General
   A. Certain inputs to the GPWS are considered hidden functions, meaning that their failure would affect system operation, but would be undetectable by available monitoring or self test. These inputs must, therefore, be tested periodically by some other means to insure adequate system reliability.
   B. This check is not intended to be a complete system checkout, and will not normally be used for troubleshooting. Its purpose is to delineate specific checks related to hidden function.

2. Equipment
   (1) Glideslope Test Unit T-30A, or equivalent (056-9165)
   (2) Radio Altimeter Tester, GR35004
   (3) Radio Tester, 110-0460-105UA
   (4) Air Data Tester Tactair (or equivalent) and Prob Adapter Kit, K18-8
   (5) Flap Position Simulator, 6SF4659

3. NAV Interface and Gear Wire Check
   A. Preparation
      (1) Apply power to aircraft
      (2) Close the following circuit breakers:
         (a) NO. 1 CADC
         (b) NO. 1 VHF NAV RCVR
         (c) GPWS AC and DC
   B. NAV Interface and Gear Wire Check
      (1) Set up T-30A test set.
         (a) On glareshield, tune VHF NAV selector to T-30A ILS test frequency.
         (b) On T-30A tester, extend the glideslope antenna.

            NOTE: It may be necessary for antenna to protrude out an open cockpit door.

         (c) Hold tester's spring-loaded flexible bar POWER SW to ON position at Glideslope end only.
            1) Meter for BATTERY CHECK should read in white area.
         (d) Set tester's COURSE switch to bottom VARIABLE position and rotate separate VARIABLE knob above and below reference line to left of knob.
            1) Horizontal bar in MHPDI should be deflected up or down in accordance with knob position.
            2) Glideslope flag should be out of view.
      (2) Set up radio altimeter tester at CTR Equipment Center.
         (a) Open ALTM LOW R 1 - Circuit Breaker, Location A3 Overhead Circuit Breaker Panel P7.

            NOTE: Refer to GN/MM-9-0-43-3 for hook-up information if needed.

(b) Gain access to CTR Equipment Center E-9, remove dust cap from TEST connector on front plate of radio ALT T/R #1 unit and connect one end of cable to TEST connector of T/R #1.
(c) Attach other end of cable to tester.
(d) Close ALTM low R1-Circuit Breaker

(3) Set up pitot-static test equipment (capt static)
(a) Wet pitot probe adapter and connect to LH upper pitot-static probe and connect static probe adapter hose to S-1 port of upper LH probe.
(b) Seal aft static port S-2 on right hand lower pitot static probe using black electrical tape.

CAUTIONS: 1) DO NOT USE TRANSPARENT OR METAL COLORED TAPE. (LEAVES RESIDUE)
2) FOR READING CAPT'S ALTIMETER, CADC #1 CIRCUIT BREAKERS D-9 THRU D-13 ON P-7 CIRCUIT BREAKER PANEL MUST BE CLOSED. CLOSE CIRCUIT BREAKER BEFORE APPLYING VACUUM TO SYSTEM.

(4) Position altitude rate valve on tester to CLOSED.

NOTE: Monitor Captain's A/S and rate of climb ind.

(5) Perform GPWS hidden function tests.
(a) Prepare test equipment
1) Verify landing gear handle is in DOWN position.
2) Verify that inboard trailing edge flaps are extended more than 25 degrees.

NOTE: Flaps can be simulated to beyond 25° by using flap position simulator 6SF4659 if required connected to LH INBD flap position sensor located #3 flap beam access 653BB.

3) Simulate a radio altitude of 1200 feet.
4) Verify CADC-1 altitude rate is set at zero feet per minute.
(b) Test glideslope GPWS warnings.
1) Using TIC tester, apply more than a 2-DOT FLY-UP glideslope deviation signal.
2) Check that no warning occurs.
3) Reduce radio altitude to 600 feet. Check that below G/S indicator lights come on flashing and a soft glideslope aural comes on at a repetition rate of about 2 to 3 seconds.

NOTE: The below G/S indicator and aural warning are referred to as G/S warning for remainder of test.

4) Set pitot static tester to about 10,000 feet altitude to allow enough time to accomplish the following step.

5) Set barometric sink rate to 3500 feet per minute. Check that glideslope audio warning ceases, the pull-up indicator illuminates, and "WHOOP WHOOP PULL UP" audio warning is actuated.
6) Set barometric sink rate to zero feet per minute. Check that pull up visual and aural warnings cease and glideslope audio warning is reactivated.
7) Reduce G/S deviation to 0 dot (center). Check that G/S warning goes off.

NOTE: Read items 11) thru 14) before continuing and note G/S deviations when warnings begin and cease.

8) Reduce radio altitude to 250 feet and slowly increase G/S deviation signal. Check that G/S warning comes on between 1 and 1-1/2 DOT fly up deviation.
9) Further increase G/S deviation signal. Check that G/S warning increases to a high level seconds when deviation increases between 1-3/4 and 2-1/4 DOTS.
10) Slowly reduce G/S deviation signal. Check that G/S warning reduces in level between 1/4 and 1/2 DOT less than when it became louder.
11) Continue slowly reducing G/S deviation signal and check that G/S warnings cease between 1/4 and 1/2 DOT less than when it came on in Step 11) preceding.
12) Reduce radio altitude to 120 feet. Increase G/S deviation signal to a 2-DOT fly up.
13) Check that G/S warning comes on with soft voice between 1-1/2 and 2-DOT fly up at a repetition rate of about once every 1-1/2 seconds.
14) Momentarily press inhibit below G/S switch located on Pilot's lightshield and check that warning goes off.

(6) Restore
(a) Remove pitot static tester
1) Relieve vacuum from static system and remove test equipment.
2) Remove tape and any residue found on static port.
(b) Remove radio altimeter tester
1) Disconnect test equipment from center elect bay and reconnect LRRA-1 dust cap.
(c) Remove flap position simulator and reconnect sensor connector (if used).
(d) Return all test equipment including T-30A signal generator, pitot-static tester and adapters, radio altimeter tester, and flap position simulator to tool crib.

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VENDOR/UA CROSS REFERENCE SUPPLEMENT

VENDOR PART NUMBER	UA STOCK STATUS

EQUIPMENT

(1) Glideslope Test Unit T-30A, or equivalent (056-9165)
LOCAL SUPPLY

(2) Radio Altimeter Tester, GR35004
LOCAL SUPPLY

(3) Radio Tester, 110-0460-105UA
056-0498 110-0460-105UA

(4) Air Data Tester Tactair (or equivalent) and Prob Adapter Kit, K18-8
LOCAL SUPPLY

(5) Flap Position Simulator, 6SF4659
LOCAL SUPPLY

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